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Statement to the Senate Commerce Committee by
Theodor Holm Nelson, Distinguished Fellow, Autodesk, Inc., and Director
of Public-Access Xanadu, 15 September 1989.

I am grateful for this opportunity to represent my company and the aspirations of many people in the computer field. I think I speak for a large number of sophisticated computer people and others concerned with communication in the world of tomorrow.

TITANIC CHANGE

We stand at the threshold of a titanic change in the use and availability of the written word, a new era of electronic literature.

I am not talking about "data bases," as we already see them in commercial use, for those have reached roughly the limit of their usefulness. The kinds of searching, flipping and scanning that they make convenient are useful in many ways to researchers, both academic and commercial, but they are difficult and largely irrelevant to the main uses of the written word: learning, study, finding out different points of view, browsing and skimming.

Nor am I talking about "videotext," a collective term for various low-grade services that have been devised for people who are basically uninterested in the written word.

Nor am I talking about the alleged joys of "CD-ROM," the selling of computer disks with a lot of stuff on them for desktop use.

Nor am I talking about "electronic mail," the increasingly popular use of computers to push letters back and forth between users at high speed, permitting individuals to exchange many communiques a day.

Nor am I talking about "teleconferencing," which in its current form is like long electronic scrolls to which different people add comments.

Nor am I talking about "bulletin boards," computer storage systems used to hold and forward materials placed on them by random outsiders.

I am talking about the coming hypertext revolution. Hypertext, I believe, is not just the latest fad in computerdom. It is the next step in civilization, and it represents a quantum step in the use, delivery and meaning of the written word comparable to that offered by Gutenberg's printing press.

The hypertext revolution will be that of on-line publishing to computer screens, by and for people using computer screens.

HYPERTEXT

Hypertext means non-sequential writing. It is practical only on computer screens.

Writing, as I believe Marshall McLuhan observed, derives its form from the medium of paper. Writing has been sequential because books were necessarily sequential. We have put numbers on our pages in the past because that was the only way to find your way around those physical objects of paper called books and magazines. But on the computer screen we no longer need numbered pages, since the reader at the screen can jump to whatever he or she wants to see next. And this leads to deep changes in the way we organize what is written and shown graphically.

The sophisticated reader does not usually read sequentially. Picking up a book, he or she flips through it, looks at the beginning, the end, the middle, the pictures; and with each step, learning more, decides what to do next. But, curiously, we still *write* as though the reader is going to read the first word, and then the second, and so on.

The computer screen is changing all that. Already, in numerous systems (such as Apple's Hypercard and Owl's Guide), users are reading and writing in nonlinear form.

THE UNIVERSAL REPOSITORY

It was in anticipation of these developments that I began this work twenty-nine years ago, and my work since then has been concerned with expanding the hypertext idea to a universal publishing system. Now the world is ready, and in the meantime the group I have gotten together has been preparing the software.

The best way to explain the overall vision is in terms of what we do not have yet.

There is not currently any convenient place where you can put data so that people can send for pieces of it and automatically pay you a royalty. Nor is there currently any place where you can find someone else's data and link your own data to parts of it. Nor is there currently any place where you can publish electronically a comment on something else that is already published electronically.

These things we intend to create, in the form of a unified repository for the storage and transmission of published data, with automatic proportionate royalty payments to the publisher.

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We hear of people creating special data repositories for music, for literature, for history, for scientific data, for graphics. This is crazy. Everything ties together. The only reasonable approach is to create a unifying repository where ALL types of data may be stored. And the only reasonable person to keep track of the integrity of each piece of data is its owner or publisher, who must also be responsible for its content (just as the publisher is now).

Such a repository may grow, we think, to hold all collectively all the writings and storage of humankind.

Such a repository cannot be kept on a big computer mainframe, because it is going to be immense, and because it has to be kept safe. It will be too big to put in one place and it would not be safe if it were in only one place. So it must be distributed on a network of many computers.

But a new kind of software is needed for this plan: a computer program that can keep track of any and all connections among these data, and keep these connections orderly as this great network of stored material grows and grows and grows.

PROJECT XANADU

For years I have called this work "Project Xanadu," and it has consisted of both aspects: the plan for a world-wide repository, and the software necessary to make it happen. Over the years the plan became more and more detailed, and I managed to assemble an extraordinary team to do the work-- the best and the brightest and most idealistic programmers I could find. Notable among these are Roger Gregory, Mark Miller, Roland King, and Eric Hill: I brought them together a decade ago and paid them nothing, and they brilliantly designed and programmed an overall system with extraordinary possibilities for immense worldwide growth. More recently they were joined by Erik Drexler, the author of *Engines of Creation*, and together they have brilliantly designed the present system. All this is described in my book *Literary Machines*.

We divided Project Xanadu into two parts: Xanadu Operating Company, Inc., to create the software and market it to business and industry, and what is tentatively called PAX, Public-Access Xanadu, to market this repository publishing scheme with automatic royalty.

Last year, after twenty-eight years of work, Xanadu Operating Company was bought by Autodesk, Inc., a world leader in software development. The chief product of Autodesk is Autocad®, the world-wide standard for computer-aided design,

which holds about 50% of the world market. Not merely throughout the United States, Europe and capitalist Asia, but even in the Soviet Union and China, the Autocad program is the standard.

The purchase of Xanadu Operating Company by Autodesk has meant new resources for the completion of the Xanadu program and its sale to business and industry, which will begin in 1990. This signals a new era in the interconnection of data. No longer must large projects and complex information be divided into separate data chunks, called "files," which must be stored under a lot of different names and be kept track of on paper. With Xanadu™ storage it will be possible to bind together huge conglomerates of data, containing many different types of data format, into unified structures with alternative versions, historical backtrack through changes, and with variants and overlays and different viewpoints on the same material. But most important will be its *connections*: inks among parts of the material and links to outside structures. Users may take note of relationships, make comments, and follow these connections interactively on their computer screens. (Through another kind of connection, called *transclusion*, the same materials may be used in many different structures without copying those materials in the new places.)

I would like use this opportunity to explain and advertise this system further, but that would be irrelevant and improper. I am here to explain how this system foretells a vast growth in the transmission of digital information, and a vast growth in the need for bandwidth throughout the United States of America.

CONNECTED INSTANT PUBLISHING

There are already numerous hypertext products on the market, including GUIDE from OWL International, Hypercard from Apple, Notecards, Hyperties, and others. All these suffer from mutual incompatibility. This means that people creating works in one hypertext system cannot connect them to works in others. This is only one aspect of the brutal incompatibilities we now see in the computer world.

Universal interconnection and possible standardization.

The Xanadu program should be able to change all that, by providing linkage forms (and new methods of data standardization) that will allow materials with many origins to share storage, to be linked together, and to be used together. Thus there is some hope for a new era of compatibility.

Open hypertext publishing.

More than this: we may look forward to *open hypertext*

publishing, where an author or commentator may add links to material prepared by someone else. This is a unique and potentially sweeping new aspect of publishing. I have discussed its ramifications, and ways to keep it orderly, in my book *Literary Machines* and elsewhere.

We live in an age of onrushing change, with greater problems than ever before; to some of us it appears that only this new prospect of open hypertext publishing, with its potential for clarifying and sifting information in a great worldwide round-table forum, offers us hope of survival.

Instantaneous delivery.

Startling to most people is the notion that published materials can be delivered right away-- potentially in seconds-- to a vast network of users, on their demand. But the technology exists; it is merely the problem of designing an integrated and useful service that holds this back. We believe that the type of linked and transclusive hypertext publishing offered by the Xanadu system is the integrated and useful service that the world has been waiting for.

Universal access.

Materials stored on the PAX™ publishing system will be available throughout the world's telephone networks, as well as over specialized connection systems that it may be convenient to set up. So essentially anybody can get at and use these materials.

In principle this is no different from your ability now to order books, journals and reprints from various sources-- publishers, libraries and retrieval services-- throughout the world. But the rapidity and ease of access should make a dramatic difference in the way that scholarly, scientific, artistic and other material will be accessible to everyone.

A franchising model.

We expect that the PAX system will be expanded, not through the backing of governments or libraries, which are very short on funds, or through large corporations, which are very short on innovation. We expect this to grow through a well-known and popular system known as franchising-- the system that has made the golden arches of McDonald's better known than the Arch of Triumph or the great arch of St. Louis. Again, I will not dwell on this marketing point, which I have made in my writings.

THE MANIFEST DESTINY OF LITERATURE

Fans of the Xanadu project, those who believe in it, consider it to be not just an off-the-wall technical development, but something very different: the natural next stage of the written word. Hypertext is not an exotic idea out of Silicon Valley (as some have

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alleged), but a form of writing that has been implicit in the written word since it began. But it could not unfold until a technical basis could be found for it, a technical basis we have now found in computer storage and on the computer screen. And the instantaneous delivery of literature-- literature in the broadest sense, the dissemination and preservation of prepared information packages that can include graphics, sound, video, statistics, laboratory information and anything else we ever digitize-- should seem no more exotic to us than the instantaneous delivery of the human voice across the telephone, or the instantaneous delivery of the human comedy by television.

THE NEED FOR BANDWIDTH

This brings me to the punch line. The Xanadu system, or something very like it, is inevitable and vital to help us with information to conquer the problems of tomorrow. But if millions of people are going to use this new form of publishing-- and I am certain that they are, both as receivers and creators-- then we are all going to need all the bandwidth we can get. Fiber is good for us, both medically and electronically. I say let's put in all the information piping we can get. As a scientific community we need it. As a free people we need it. From every mountainside let circuits ring, and let the chips install where they may.

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